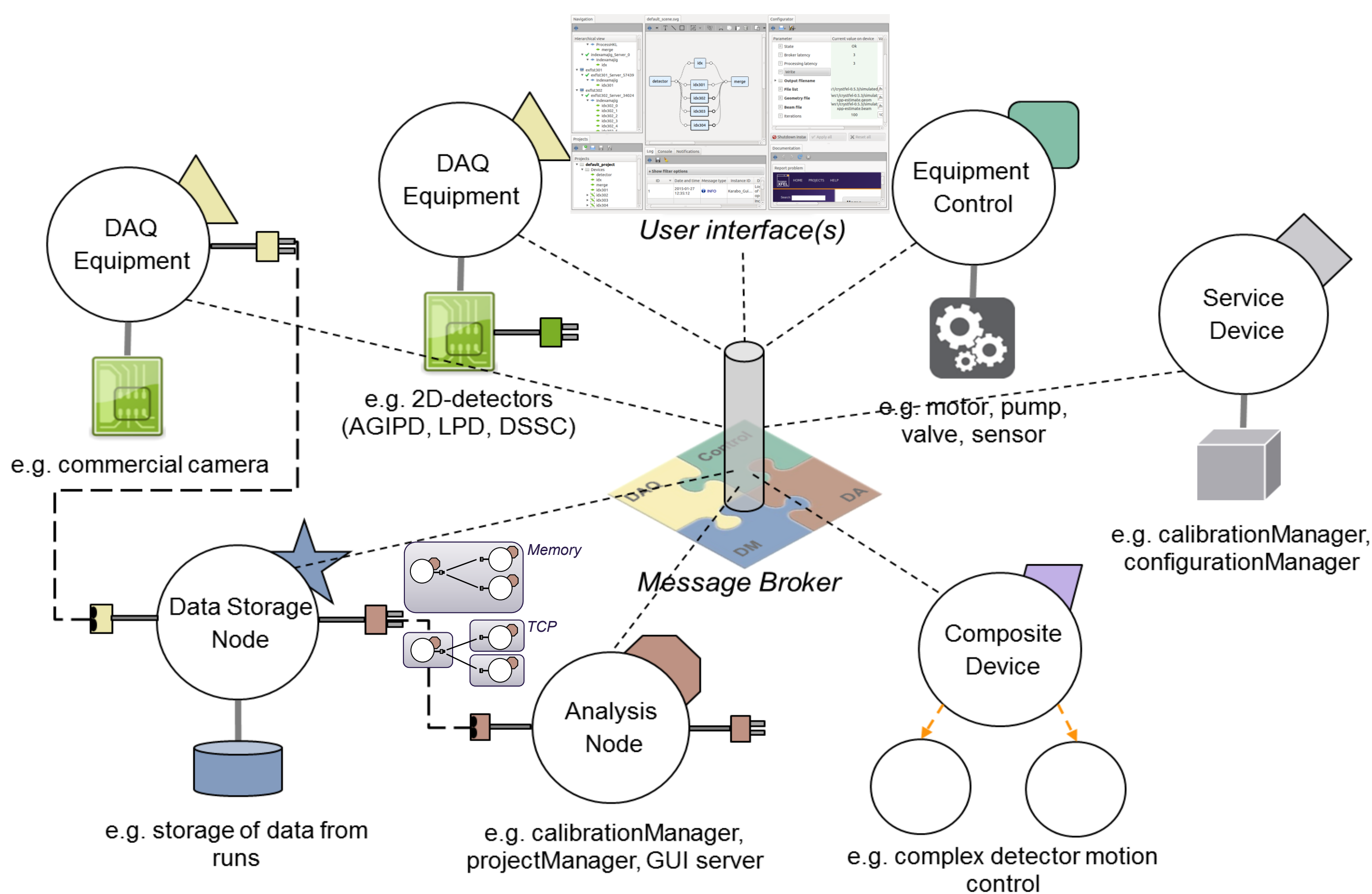


## Karabo, the Control and Analysis System for the European XFEL

S. Brockhauser, S. Esenov, G. Flucke, G. Giambartolomeo, D. Goeris, S. Hauf, B. Heisen, M. Messerschmidt, A. Parenti, A. Silenzi, M. Teichmann, K. Weger, J. Wiggins, C. Youngmann

European X-Ray Free Electron Laser Facility GmbH, Holzkoppel 4, 22869 Schenefeld, Germany

**ABSTRACT** The European XFEL is a 3.4 km long X-ray Free Electron Laser in its final construction and commissioning phase in Hamburg. It will produce spatially coherent X-rays in the energy range between 0.25 keV and 25 keV. The machine will deliver 10 trains/s, consisting of up to 2700 pulses/trains at 4.5MHz repetition rate. In 2015 a first electron beam was produced in the RF-photo-injector and the commissioning of consecutive sections are ongoing. A huge number and variety of devices for the accelerator, beamlines, experiments, cryogenic and facility systems needs to be controlled together. Data acquisition requires a precise timing and synchronisation system. Fast feedbacks from front-ends, the DAQs and online analysis system must be seamlessly integrated and provided for the accelerator and the initial 6 experimental stations. An overview of the XFEL control system, Karabo is presented.



■ **FXE**  
Femtosecond X-ray Experiments

■ **SPB/SFX**  
Single Particles, clusters, and Biomolecules

■ **SCS**  
Spectroscopy & Coherent Scattering



■ **SQS**  
Small Quantum Systems

■ **HED**  
High Energy Density Science

■ **MID**  
Materials Imaging and Dynamics

### KARABO 2.0

#### ■ Low Level Control System (C++/Python)

Direct access to hw with unified *State, Alarm* and *Error* management  
Support for seamless hw **simulation** with physics engine  
Configuration database to manage hw settings

#### ■ Middle Layer Devices (Python)

#### ■ Macro Services (GUI + CLI)

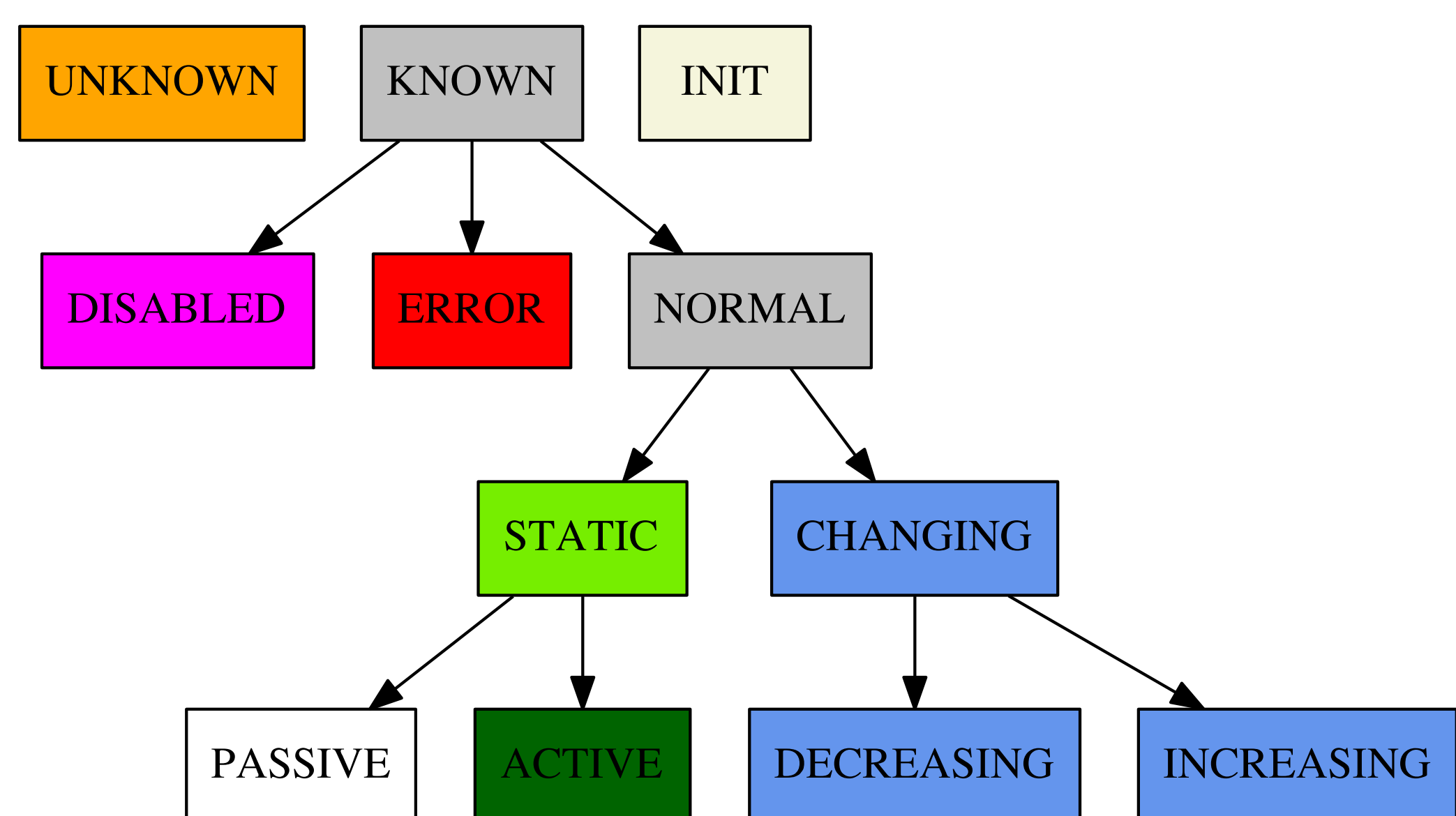
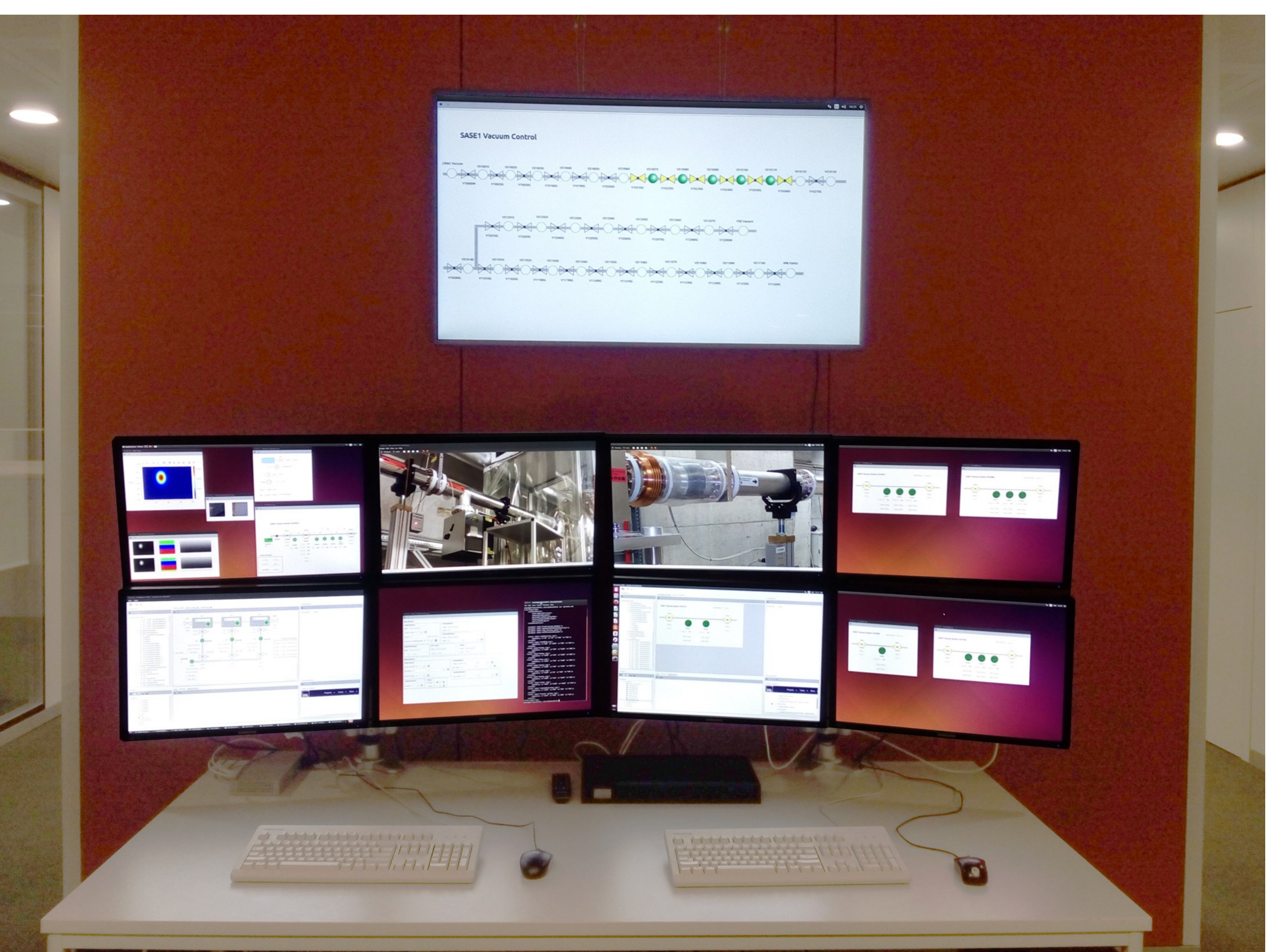
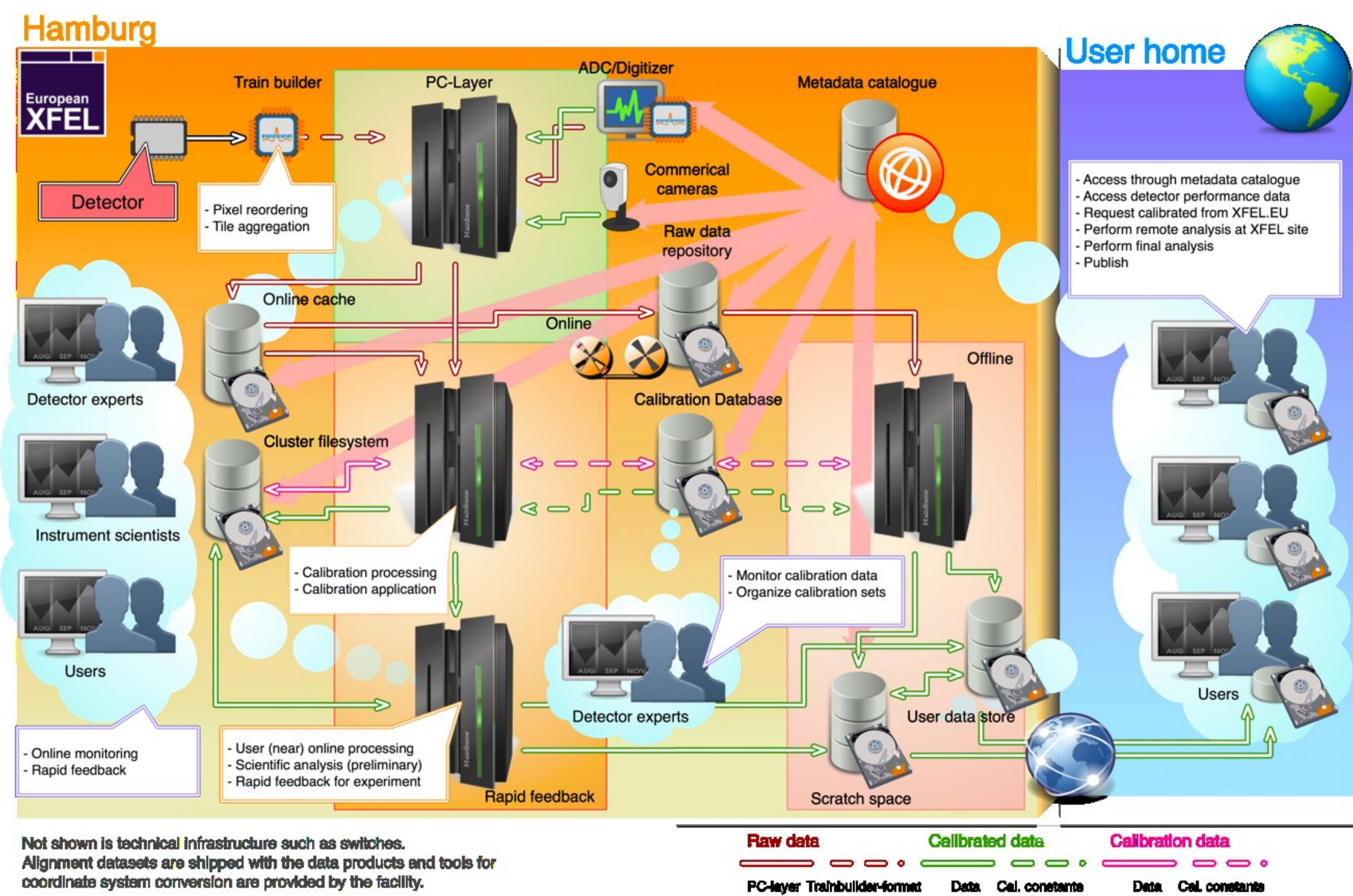
#### ■ Data Analysis Pipeline

Full **workflow** engine with designer  
Optimised data throughput

#### ■ GUI with Designer and Basic Widget Set

Device Browser and Configurator  
Configurable control and analysis screens

#### ■ CLI with iPython Integration



Fixed set of states. All other states derive from these.

Control Room Mockup runs Karabo in simulated environment